

A FOSSIL FLOWER OF *PERSEA* (LAURACEAE)
IN TERTIARY DOMINICAN AMBER

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ABSTRACT

Persea avita sp. nov. is described from a flower in Tertiary Dominican amber. The absence, through post-anthesis loss, of 2 of the 3 large, inner tepals of the fossil allows an interior view of the remaining fertile stamens and developing ovary. If correctly placed in *Persea*, the species probably belongs to subgen. *Eriodaphne*, sect. *Aurataea*, in which the 3 outer tepals are smaller than the inner, the ovary is pubescent, and the fertile stamens are 9 in number. In the fossil, 2 of the staminodia of Series IV are apparently missing, having been lost along with the 2 absent tepals of the inner whorl and their associated Series II stamens. The 11 species of sect. *Aurataea* are presently limited to South America (Kopp 1966).

RESUMEN

Persea avita sp. nov. se describe de una flor el ámbar Terciario Dominicano. La ausencia, por pérdida post-antesis, de 2 de los 3 tépalos grandes internos del fósil permite una vista del interior con los estambres fértiles que permanecen y el ovario en desarrollo. De estar correctamente colocado en *Persea*, la especie probablemente pertenece al subgen. *Eriodaphne*, sect. *Aurataea*, en la que los 3 tépalos externos son más pequeños que los internos, el ovario es pubescente, y los estambres fértiles son 9. En el fósil, 2 de los estaminodios de la serie IV están perdidos aparentemente, habiéndose perdido junto con los 2 tépalos ausentes del verticilo interno y su Serie II de estambres asociada. Las 11 especies de la sect. *Aurataea* están limitados actualmente a Sur América (Kopp 1966).

INTRODUCTION

Remains of organisms found embedded in amber include animals, especially terrestrial invertebrates, and plant parts, such as flowers, pollen, leaves, bryophyte stems, and wood fragments (Poinar 1992; Poinar & Poinar 1999). The preservation of flowers in three-dimensional form may allow their assignment to modern genera (Poinar et al. 2008a, revised by Chambers & Poinar 2010; Chambers et al. 2011) or to novel genera of either verifiable or uncertain affinity (Conwentz 1886; Poinar & Chambers 2005; Poinar et al. 2008b; Chambers et al. 2010). The majority of described amber flowers are from Baltic deposits (Spahr 1993), but the above-cited reports include both Mid-Tertiary Dominican amber and Early Cretaceous Burmese amber.

In an ongoing investigation of Dominican amber, we discovered a flower that is clearly referable to family Lauraceae. Despite its being past anthesis and not in prime condition, it retains a combination of features that favors an assignment to the genus *Persea*, with affinity to species of sect. *Aurataea*. In consideration of its Mid-Tertiary age and its occurrence outside the South America range of the section, we propose its description under the new name *Persea avita*.

MATERIALS AND METHODS

The fossil originated from mines in the northern mountain range (Cordillera Septentrional) of the Dominican Republic, between the cities of Puerto Plata and Santiago. Dating of Dominican amber is controversial, with a youngest proposed age of 20–15 mybp based on foraminifera (Iturralde-Vinent & McPhee 1996) and an oldest

of 45–30 mybp based on coccoliths (Cêpek in Schlee 1999). Most of the amber is secondarily deposited in turbiditic sandstones of the Upper Eocene to Lower Miocene Mamey Group (Draper et al. 1994).

DESCRIPTION

Persea avita K.L. Chambers, Poinar, & A.E. Brown, sp. nov. (Figs. 1–6). TYPE: HISPANIOLA, DOMINICAN REPUBLIC: amber mine in the northern mountain ranges (Cordillera Septentrional), 1995, *unknown amber miner s.n.* (HOLOTYPE: catalogue number Sd-9-180, deposited in the Poinar amber collection maintained at Oregon State University, Corvallis, Oregon 97331, U.S.A.).

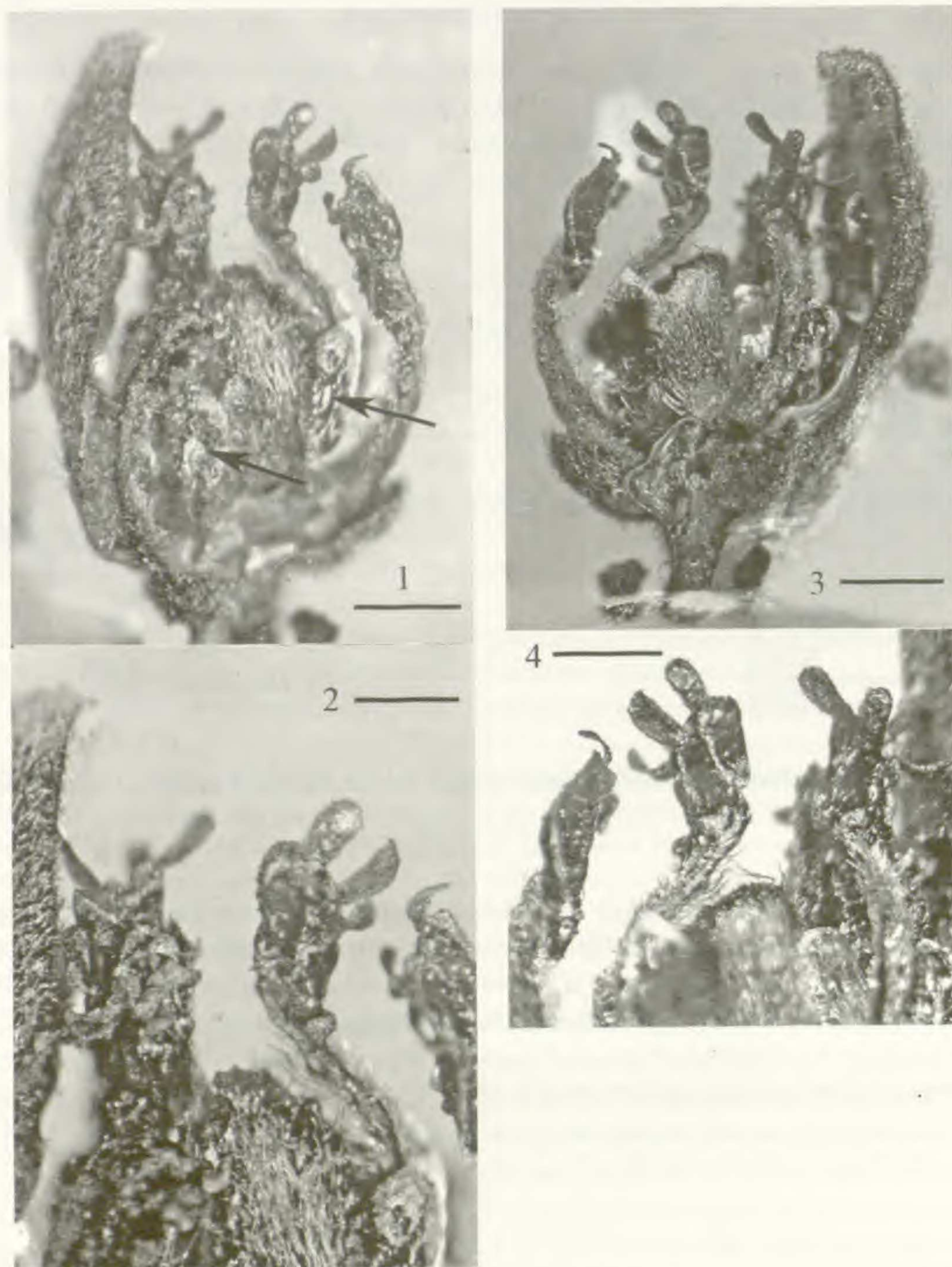
Flower perfect, post-anthesis, remaining pedicel 0.53 mm, not swollen, receptacle flat, hypanthium (cupule) none, perianth parts originally 6 (2 inner tepals missing), outer tepals ovate-deltoid, 1 mm long, densely strigose abaxially (adaxial side not visible), remaining inner tepal 4.3 mm long, elliptic-lanceolate, densely strigose ad- and abaxially, fertile stamens originally 9 in 3 series (6 stamens remaining: 1 first-whorl stamen represented only by a basal filament stub, 2 stamens of second whorl completely missing), filaments 1.3–2.0 mm long, linear, curved adaxially, densely puberulent, short-stalked, basally-attached, glands present on third-whorl stamens, glandular portion 0.8–1.0 mm (Fig. 1), anthers 0.8–1.1 mm, originally 4-locular (some pollen sacs possibly merged before or after anthesis), remaining valves uplifted distally or laterally, anthers of Series I and II introrse, of Series III latrorse or extrorse, staminodia of innermost series assumed to be 3 (2 missing, 1 not in observable position), developing ovary superior, 1.7 mm long, 0.9 mm wide, densely strigose, style deciduous.

Etymology.—from the Greek “avitus,” ancestral, grandfatherly.

DISCUSSION

The flower is post-anthesis, as evidenced by the developing ovary and loss of some tepals, stamens, glands, and staminodes. The remaining stamens are 2 of Series I, 1 of Series II, and 3 of Series III. Two of the anthers appear to have just 2 large anther sacs, but this may be due to confluence of the paired locules. Four of the 6 basal glands on the Series III stamens can be seen. While no Series IV staminodes are visible, our assumption is that 2 have been lost in conjunction with the loss of their associated large tepals and Series II stamens, but that the third may be present, although hidden by its adjacent Series III fertile stamens. It is not obvious whether the absent floral parts were naturally dehiscent or were removed by insect predation; however, we favor the latter possibility. Our suggested placement of the flower in subgen. *Eriodaphne* requires that the perianth parts be persistent rather than deciduous (van der Werff 2002). The New World genera *Aniba* and *Aiouea*, with Series IV staminodia inconspicuous or absent, differ from the fossil in their 2-loculed anthers (Kubitzki 1982; Renner 1982). There are several Old World genera that lack such staminodia, as described by Pax (1891) and Rohwer (1993), but we excluded them as possible congeners of this New World amber species. To identify possible extant relatives of the fossil, we reviewed the New World genera listed by these authors, as well as the annotated list of genera in Little (2006, tab. 5.1). The fossil is well accommodated in *Persea* sect. *Aurataea* with respect to the pubescence of its tepals, filaments, and ovary (Kopp 1966), as well as its comparatively small outer tepals. The length and shape of the filaments and anthers, the number and arrangement of anther locules, the directions of anther dehiscence, and the absence of a receptacular cupule are typical of this genus, as well (Allen 1945, 1948; van der Werff 1991).

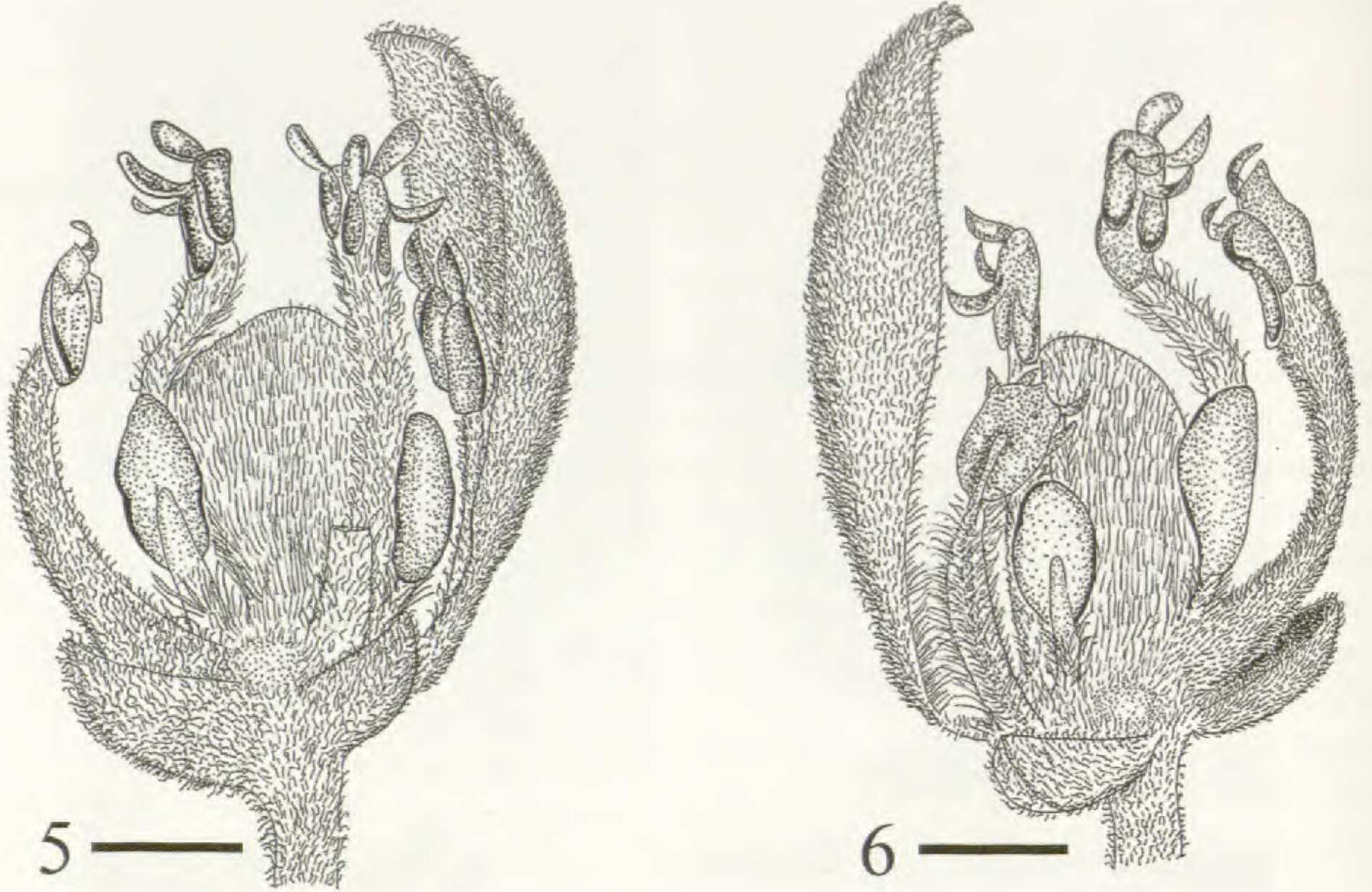
The possibility of an alternative placement was suggested by H. van der Werff (pers. comm.), involving *Corydodaphnopsis*, a genus once known only from southeast Asia (Kostermans 1974) but later identified also from Central and South America (van der Werff & Richter 1985; van der Werff 1986; Zamora et al. 1988). Identification of this genus is principally by the vegetative features of opposite leaves and details of wood anatomy (van der Werff & Richter 1985; Zamora et al. 1988), the interspecific variation in some floral characteristics making generic characterization difficult. This applies especially to the anthers, which may have only two pores or, if four pores, then these are arranged either in an arc or in pairs, one above the other. The filaments are characteristically no longer than the anthers, but in the New World species *C. fosteri* and *C. burgeri*



FIGS. 1–4. *Persea avita*. 1. Side 1 of flower. Arrows indicate glands of Series III stamens. Scale bar = 0.70 mm. 2. Enlarged view of anthers, ovary, and gland of Side 1. Scale bar = 0.56 mm. *Persea avita*. 3. Side 2 of flower. Air bubble occupies split in ovary wall, gland of Series III stamen on left obscured by extraneous particle in amber. Scale bar = 0.75 mm. 4. Enlarged view of anthers and ovary apex of Side 2. Scale bar = 0.73 mm.

they are 2–4 times the anther length. The ovary is usually glabrous (Kostermans 1974), but it is pubescent in *C. fosteri* and *C. burgeri* (van der Werff 1986; Zamora et al. 1988). The staminodes, except in *C. burgeri*, are short-stalked, and the glands of the Series III stamens are relatively large. A similarity between this genus and the Dominican fossil is the relatively small outer tepals, a trait also seen in *Persea*, as in *P. nivea* of section *Aurataea* (Kopp 1966, fig. 9).

Given that we have no access to the critical vegetative features mentioned above, the variability in floral characteristics of *Corydodaphnopsis* make an assignment to that genus too uncertain, in our opinion, but attention can be called to the fossil's similarity in perianth, stamens, and ovary to certain New World species, especially *C. burgeri* of Costa Rica.



FIGS. 5–6. *Persea avita*. 5. Reconstructive drawing of Side 2. Air bubble removed to show complete ovary. Scale bar = 0.73 mm. 6. Reconstructive drawing of Side 1. Scale bar = 0.70 mm.

The Lauraceae have a long fossil history, with clearly identified Cretaceous floral remains dating from the Early Albian, Cenomanian, and Turonian (Drinnan et al. 1990; Herendeen et al. 1994; Eklund 2000; Friis et al. 2006; von Balthazar et al. 2007). A summary of Tertiary Lauraceae fossils recorded from the North American Plate was given by Taylor (1988), in conjunction with the description of Middle to Upper Eocene *Androglandula* of tribe *Cinnamomeae*. An unpublished genus of Lauraceae from the Middle Eocene of British Columbia was described by Little (2006) and illustrated (Little et al. 2009), with emphasis on fruit anatomy and development. The fossil lacks staminodia and differs from ours in having large outer tepals, bilocular stamens, and a glabrous ovary. A molecular clock analysis of the family was attempted by Chanderbali et al. (2001). The best resolution for a selected group of species of the tribes *Perseeae* and *Laureae* (in the sense of Rohwer 1993) was provided by the ITS/5.8S region of nrDNA. This showed a date of 45 mybp for the separation of the *Persea* subgroup (3 species of *Persea* and 1 of *Apollonias* sampled) from a clade joining the *Ocotea* subgroup and tribe *Laureae*. The approximate age of the Dominican amber, 20–30 mybp, is thus in accord with a Mid-Tertiary evolution of *Persea*, based on this single-gene estimation of molecular clock dating. To the best of our knowledge, the present specimen is the first fossil record for this genus.

A molecular phylogenetic study of Lauraceae by Rohwer (2000), using the cpDNA *matK* gene, confirmed that the *Persea* group of genera (a sample of *Persea*, *Apollonias*, *Alseodaphne*, and *Dehaasia*) is monophyletic. More recently (Rohwer et al. 2009), a phylogenetic study based on nrDNA ITS sequences in a sample of 61 species of the *Persea* group, raised the possibility that *Persea* itself, as currently delimited, is polyphyletic. Species of subgen. *Eriodaphne* are in a clade separate from that containing members of subgen. *Persea*. The authors suggest that subgen. *Eriodaphne* will ultimately have to be treated taxonomically as the separate genus *Mutisiopersea*, should this cladistic relationship be confirmed by later molecular analyses. However, separate generic status for subgen. *Eriodaphne* is not supported by the results of Li et al. (2011), based on molecular phylogenetic analysis of the combination of ITS and *LEAFY* intron II.

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